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STUDIES IN THE INHERITANCE OF COLOR IN PERCHERON HORSES.

E. H. HARPER.

I. The Influence of Selection and Inbreeding upon Prepotency.

The materials for this paper have been drawn from the records of the American and French Percheron Horse Breeding Associations. The data obtainable from breeders' books have been used extensively within recent years in the investigation of problems of heredity. The "Law of Ancestral Heredity" formulated by Galton and revised by Karl Pearson is the foremost of the deductions claimed as a result of the study of such data.

The information furnished by the Percheron register is in respect to color, sex and age, and the questions proposed in this paper involve the three sorts of data available. Three questions have been made the subject of investigation: (1) To what extent a color which has been predominant in the breed in the past shows any prepotency over a color which has been increased by breeders' selection. The case with the Percherons is that gray has been the predominant color, but black is on the increase. (2) A second question has been raised as to normal inheritance from parents of different ages, whether parents of greater age influence the offspring to a greater extent, and whether there is an optimum age of prepotency. (3) Whether either sex is prepotent over the other.

At the outset of this investigation the writer started to test the "Law of Ancestral Heredity" of Galton. To this end was collected the complete ancestry of 179 individuals up to the third ancestral generation, showing the colors of parents, grandparents

and great-grandparents. The results showed that a secular change has been in progress in the breed increasing the per cent. of black individuals. The figures are given in Table I.

The per cent. of grays among the great-grandparents was 58, and this declined to 47 per cent. among the grandparents and

TABLE I.

		G.-G.-P.	G.-P.	P.	Offspring.
White or Gray.	No. of Sires.	368	140	68	♂ 34
	No. of Dams.	458	200	73	♀ 30
	Total.	826	340	141	64
	Per Cent.	57.68	47.48	39.38	35.75
Black.	No. of Sires.	327	190	81	♂ 40
	No. of Dams.	198	140	93	♀ 51
	Total.	525	330	174	91
	Per Cent.	36.66	46.08	48.60	50.83
Bay, Brown and Chestnut.	No. of Sires.	21	28	30	♂ 9
	No. of Dams.	60	18	13	♀ 15
	Total.	81	46	43	24
	Per Cent.	5.65	6.42	12.01	13.40
	Totals.	1,432	716	358	179

to 39 per cent. among the parents. Corresponding to these there was a rise in the per cent. of blacks from 37 per cent. among the great-grandparents to 46 per cent. of the grandparents and 49 per cent. of the parents. There was also an increase in the bay-brown group from 6 per cent. to 12 per cent.

These facts correspond to the testimony of breeders in regard to the increasing popularity of black. The preference or fashion for black seems to be leading to a gradual change from the formerly predominant gray color of the breed which prevailed in its place of origin in France. The gray-white group of colors includes a number of minor varieties and is the outcome of former generations of inbreeding of animals of this color.

The 179 offspring whose ancestry has been traced are themselves divided as follows among the three color groups: Gray 64, black 91, bay-brown 24. This is a showing of 51 per cent. of blacks among the offspring, which is in excess of the per cent. found among the parents. Doubtless this is an exhibition of the breeders' preference for black which has led to an excessive registration of animals of the favorite color. The expense of

registration must be considered as a factor. Thus the 179 individuals are not in all probability a representative population, owing to the elimination of grays from the register.

It should be added that this is the surface explanation of the facts, which might be accounted for partly at least in other ways, as by an actual prepotency of the black color, or by a melanic tendency due to effect of change of climate on the breed on removal from its original home in France to America. All of the offspring and parents and almost all of the grandparents are American registered animals. It is chiefly in the great-grandparental generation that the French records have been drawn upon.

The following description of the Percheron breed is taken from a work on "The Horse" by Roberts (Macmillan, 1905): "About 1820 two noted gray Oriental stallions, Godolphin and Gallipoli, were introduced into the Government stables at Pin. These two prepotent stallions fixed the style of color and fastened it on an already susceptible breed (p. 159). . . . The color of most Percherons is gray of varied shades. Sometimes it is quite light, becoming nearly pure white in old age. Again, the striking light and dark dapples are seen, and dark grays, almost black, with a few white hairs. Comparatively few blacks have, as yet, been bred, although dark colors are sought and are more common than formerly. The American purchaser prefers darker rather than lighter colors; hence the effort in France is to produce darker colored animals than formerly. . . . It will take many generations to entirely eliminate the light colors, so long one of the characteristics of the breed; but this will be accomplished in time if Americans persist in preferring dark- rather than light-colored draft-horses. This preference is not founded on a fad, for, other things being equal, dark-colored horses are to be preferred to light-colored ones" (p. 162 ff.).

From all that we know of the history of the breed it is quite obvious that the increase in black and decrease in gray through four generations, shown in Table I., is at least partly a result of breeders' selection, and would not warrant the assumption of a melanic tendency or prepotency of black. Indeed, it is quite equally obvious that we should expect the long predominant color, gray, to be the prepotent color. Independent data have

been collected which bear upon this point, and the same data have been tabulated with reference to the two other matters mentioned at the outset, the prepotency of sex and the relation of age to prepotency.

The Selection of Data to Determine Prepotency.

With the view of determining certain of the factors of prepotency, two thousand individuals of pure black or gray color have been selected at random, consisting of one thousand colts and one thousand fillies, the parents likewise being of pure color, one black the other gray. This method of selection gives a positive resemblance of the offspring to the one or the other parent. It seemed to the writer that the pure colors were the only ones from which inferences could be drawn, since the descriptions of color are too meager to warrant a safe inference in cases of parents or offspring of mixed color. It would be impossible in the case of mixed colors to decide which was the preponderating color or to infer the resemblance of the offspring to one or the other parent. This defect is apparently inherent in data not originally collected for any scientific purpose. Any consideration of the Mendelian hypothesis is precluded. And while that fascinating theory would naturally be the first to turn one's attention to investigations of this sort, it has seemed that the limited use of data as above outlined might prove to be warrantable as a method for certain purposes proposed in this this paper. All of the data presented in this paper outside of Table I. consist of that just referred to, namely, the 2,000 individuals selected at random according to the method described, and including 1,000 colts and 1,000 fillies.

Table II.

Prepotency in Relation to Sex.

	Sire Prepotent.	Dam Prepotent.	Totals.
Colts	457	543	1,000
Fillies	463	537	1,000
Totals	920	1,080	2,000
Per Cent.	46	54	

In Table II. the data are arranged with reference to sex prepotency. It is seen that of 1,000 colts 543 or 54.3 per cent.

resemble the dam, and of 1,000 fillies 537 or 53.7 per cent. resemble the dam, or the dam is prepotent in 54 per cent. of all cases. The ratio between the prepotency of dam and sire is a little less than 5:4.

In the next table the sexes are separated on the basis of color and we find that gray dams and black sires are greatly in excess, being nearly 75 per cent. of the whole number.

TABLE III.—*Colts.*

PREPOTENCY IN RELATION TO BOTH SEX AND COLOR.

Sires.	Black.	Per Cent.	Gray.	Per Cent.	Totals.
Prepotent.....	333	44.04	124	50.81	457
Non-prepotent ...	423		120		543
Totals.	756		244		1,000
Dams.					
Prepotent.....	120	49.19	423	55.96	543
Non-prepotent ...	124		333		457
Totals.	244		756		1,000

TABLE IV.—*Fillies.*

Sires.	Black.	Per Cent.	Gray.	Per Cent.	Totals.
Prepotent.....	322	44.98	141	49.65	463
Non-prepotent	394		143		537
Totals.	716		284		1,000
Dams.					
Prepotent.....	143	50.35	394	55.02	537
Non-prepotent	141		322		463
Totals.	284		716		1,000

Taking the table for the 1,000 colts first, we find that there are 756 black sires and 244 gray sires, and correspondingly 756 gray dams and 244 black dams. The gray dams moreover are prepotent in 56 per cent. of the cases and the black dams in only 49 per cent. The gray sires are prepotent in 51 per cent. of the cases and black sires in 44 per cent. These figures do not essentially alter the previous results as to the prepotency of the dam but indicate that the gray dam is more prepotent than the black dam and the gray sire than the black sire. But the gray sire is less prepotent than the gray dam (51:56). The relations may be expressed thus: The combination of prepotent sex + sub-

potent color (B ♀) = subpotent sex + prepotent color (G ♂). For the prepotencies are nearly equal in this case (49.2:50.8).

The figures for the 1,000 fillies are nearly the same as for the colts (Table IV.). The black sires and gray dams are in excess as before, there being 716 black sires to 284 grays and correspondingly 716 gray dams to 284 blacks. The gray dams are prepotent in 55 per cent. of the cases, black dams in about 50 per cent.; gray sires in about 50 per cent., black sires 45 per cent. Here also the gray dams are more prepotent than the gray sires (55:50). Also the relation holds as before expressed. B ♀ = G ♂ (50.3:49.7).

TABLE V.

PREPOTENCY IN RELATION TO COLOR.

	Prepotent.	Per Cent.	Non-prepotent.	Per Cent.	Totals.
Gray parents.....	1,082	54.1	918	45.9	2,000
Black parents	918	45.9	1,082	54.1	2,000
Totals.....	2,000		2,000		4,000

In Table V. are condensed the data of III.-IV. arranged with reference to color alone. From this it is seen that gray parents are prepotent in 54.1 per cent. of the cases. Oddly enough this almost coincides with the prepotency of dams (Table II.) which was 54 per cent. This curious result comes from the fact pointed out above that black dams mated with gray sires are almost equal in prepotency in the case of both colts and fillies. Consequently the whole difference between the prepotency of gray and black parents arises from the unions between gray dams and black sires in which the gray dams are prepotent in 55–56 per cent. of the cases.

These results show from data independent of Table I. that black is not a prepotent color. Therefore the secular change shown in the increase of black in Table I. must be due to breeders' selection. It is also evident that breeders' preference is exercised by the more frequent use of black stallions. Although stallions are chosen for their individual superiority and prepotency it would seem that their superiority is not sufficient to make them prepotent as to color in the majority of cases. The original color of the race, gray, is prepotent, having behind it the hereditary force of previous generations of inbreeding. In the inheritance of color the tendency is to return to the original gray.

About 75 per cent. of the parents of grays are gray while only 60 per cent. of the parents of black individuals are black. This was found to be the case with the parents of 300 grays and 300 blacks selected at random from data not included in the rest of this paper. Thus the reason for the prepotency of gray is manifest from the average character of its ancestry.

The prepotency of the dam seems to be partly explained by the fact that gray dams are most numerous, but this does not wholly explain the dam's prepotency. For gray dams are prepotent in a higher degree than are gray sires (56:51 for colts; 55:50 for fillies).

It must be remembered that we are dealing with the recorded colors as yearlings and that a certain per cent. of color changes must occur later on. It would be interesting, for example, to have data bearing upon the question whether the young of both sexes tend to resemble the dam.

Pearson ('01) finds in respect to the inheritance of eye-color in man, "That the younger generation takes as a whole more after its male than its female ascendents and collaterals." In this paper the prepotency of the dam has been shown to be partly the result of association with a prepotent color, but this factor does not wholly explain the dam's prepotency although it diminishes her apparent prepotency.

The conclusion that the prepotency of the gray color is the effect of inbreeding owing to its long established existence as a racial characteristic in this breed may suggest the question as to how long would be required for the black color to become fixed by long continued selection and inbreeding. There may be some evidence as to the point in the data contained in Table XV. (see Appendix). Of the 91 black offspring 38 had both parents and at least half of the grandparents and great grandparents black. Moreover all the individuals having that amount of black in their ancestry were black. Of course this apparent result must be largely caused by breeders' selection, eliminating grays from the records. If it has any force at all as an exhibition of the effects of the cumulation of black in the near ancestry it would go to show that the selected color tends to become stamped in "indelibly" so to speak after a few generations of selective inbreeding. Any such facts, if proved, would of course

militate against Galton's or Pearson's law which ascribes a continued influence to the remote ancestry. The influence of the ancestral generations diminishes according to Galton's hypothesis in the series —.50, .25, .125, .0625, etc. According to Pearson's, a greater influence is ascribed to the remote generations, the series (numbered II.) running as follows —.50 (parental influence), .33 (grandparental influence), .22 (great-grandparental influence), .15 (great-great-grandparental influence).

II. Is There a Correlation Between Age and Prepotency?

The remaining question proposed in this paper is whether there exists any relation between age of parents and prepotency. Whether there is an optimum age of prepotency in either parent and the power of influencing the character of the offspring increases up to this point.

The data have been first arranged in two groups for the two sexes. The 1,000 colts are treated in Table VI. (*a*) and the 1,000 fillies in Table VI. (*b*).

Table VI. (*a*).

Colts.

	Sire of Same Age, or Older.	Per Cent. of Prepotency.	Sire Younger.	Per Cent. of Prepotency.	Totals.
Sire prepotent.....	265	46.50	192	44.66	457
Dam prepotent.....	305	53.50	238	55.34	543
Totals.....	570		430		1,000

Table VI. (*b*).

Fillies.

	Sire of Same Age, or Older.	Per Cent. of Prepotency.	Sire Younger.	Per Cent of Prepotency.	Totals
Sire prepotent.....	283	47.89	180	44.01	463
Dam prepotent.....	308	52.11	229	55.99	537
Totals.....	591		409		1,000

Table VI. (*a*) shows that dams are slightly more prepotent when older, or in 55.3 per cent. of the cases against 53.5 per cent. where the sire was older or of the same age.

In the table of the fillies VI. (*b*) the dam is seen to be prepotent in 56 per cent. of the cases when older, as against 52 per cent. when younger or of the same age with the sire. These differ-

ences are slight and consistent in case of both colts and fillies in making the dam more prepotent when older and correspondingly the sire less subpotent when older.

In order to see whether there appears to be an optimum age of prepotency the data have been arranged in a number of tables that follow. In the mating of domestic animals a greater variety of crosses with regard to the respective ages of the parents is of course met with than in man. In marriage the man is ordinarily older, but among horses we have all possible combinations occurring frequently.

In arranging the data to determine if there be an optimum age the parents have been grouped as follows: I., very young, 3–4 years old. II., young, 5–7. III., medium age, 8–10. IV., older, 11–13. V., very old, 14 and over.

In Table VII. which follows are given all cases in which dams were mated with very young sires.

TABLE VII.

Sires 3 to 4 Years.	Sire Prepotent.	Dam Prepotent.	Per Cent. of Prepotency of Dam.	Totals.
Colts	77	106	57.92	183
Fillies	72	110	60.43	182
Totals	149	216	59.17	365

When the sire is very young 58 per cent. of the colts and 60 per cent. of the fillies resemble the dam, or the prepotency of the dam is 59 per cent. as against the average prepotency of 54 per cent. derived from Table II.

Naturally we would take next for consideration the prepotency of dams mated with very old sires, 14 and over. There were only 70 such cases in the 2,000. They show that 66 per cent. of the colts and 63 per cent. of the fillies resemble the dam, an average prepotency of the dam of 64 per cent.

TABLE VIII.

Sires of 14 Years and Older.	Sire Prepotent.	Dam Prepotent.	Per Cent. of Prepotency of Dam.	Totals.
Colts	10	19	65.55	29
Fillies	15	26	63.41	41
Totals	25	45	64.28	70

Now leaving out very young and very old sires, the cases in which dams were mated with sires 5–13 years of age are given, first for colts and then for fillies.

TABLE IX.

COLTS. SIRES 5–13 YEARS OLD.

Age of Dam.	3–4 Years.	5–7 Years.	8–10 Years.	11–13 Years.	14 Years +.	Totals.
Sire prepotent.....	82	150	85	34	19	370
Dam prepotent.....	80	159	104	55	20	418
Prepotency of dam.	49.38%	51.45%	55.02%	61.79%	51.28%	788

When the dams are grouped as above from young to old — the prepotency of the dam runs along in a series above shown — 49, 51, 55, 62, 51, apparently showing an optimum period of prepotency somewhere in middle age. In Table X. dams mated with sires of 8–10, a more homogeneous group, are considered.

TABLE X.

COLTS. SIRES 8–10 YEARS OLD.

Age of Dam.	3–4 Years.	5–7 Years.	8–10 Years.	11–13 Years.	14 Years +.	Totals.
Sire prepotent.....	24	51	20	13	8	116
Dam prepotent.....	15	58	38	22	7	140
Prepotency of dam.	38.46%	53.21%	65.51%	62.85%	46.66%	256

Here the dam's prepotency makes a series — 38, 53, 66, 63, 47, the maximum being in middle age. In the next table the results for fillies are given.

TABLE XI.

FILLIES. SIRES 5–13 YEARS OLD.

Age of Dam.	3–4 Years.	5–7 Years.	8–10 Years.	11–13 Years.	14 Years +.	Totals.
Sire prepotent.....	80	153	95	39	9	376
Dam prepotent.. ..	88	142	114	40	21	401
Prepotency of dam.	52.4%	48.1%	54.54%	50.6%	70%	
	(average)			(average)		
	49.67			55.96		777

It may be noted that in the last table the prepotency of the dam does not show a regular increase nor run to so high a point at any age as in the table of colts. On the whole, however, there is a rise in the prepotency of the dam with age.

In the previous tables dams were taken of all ages. In the next are given all the cases where very young dams were mated with very young sires.

TABLE XII.

Sire and Dam 3 to 4 Years.	Sire Prepotent.	Dam Prepotent.	Per Cent. of Prepotency of Dam.	Totals.
Colts.....	20	33	62.26	53
Fillies.....	22	31	58.49	53
Totals.....	42	64	60.37	106

The dam's prepotency is high, where the ages are on an equality and just as high as in Table VII., where the dam had the supposed advantage of age.

Next is given a table showing very young dams mated with sires 5–13, the more prepotent sires.

TABLE XIII.

Dam 3 to 4, Sire 5 to 13 Years.	Sire Prepotent.	Dam Prepotent.	Per Cent. of Prepotency of Dam.	Totals.
Colts.....	82	80	49.38	162
Fillies.....	80	88	52.32	168
Totals.....	162	168	50.90	330

This table shows an equality as to prepotency between very young dams and the more prepotent sires. In Table XIV. very young dams mated with sires of all ages are included.

TABLE XIV.

Dam 3 to 4 Years.	Sire Prepotent.	Dam Prepotent.	Per Cent. of Prepotency of Dam.	Totals.
Colts.....	103	119	53.60	222
Fillies.....	105	124	54.10	229
Totals.....	208	243	53.87	451

Now let us compare the results of the last three tables, XII.–XIV., and see if there is any consistent relation between these results. Arranging them so as to show an increasing prepotency for the dam, we find that dams 3–4 years of age mated with the more prepotent sires 5–13 (Table XIII.) are least prepotent. Next comes the case of young dams mated with sires of all ages, with a prepotency of 53.8 per cent. Still more prepotent are young dams mated with their equals in age (60 per cent.)

The number of cases in which very old dams occur is too small to permit a tabulation in this manner. The results for

these and for dams of medium age can be seen by inspection of Tables IX.–XI. without any farther tabulation of the data.

We find the following idea expressed by Redfield ('03) in respect to the influence of age upon prepotency: "As between two individuals of the same breed, the same rule probably holds, that the individual which has had its characteristics more firmly fixed by inbreeding will be prepotent. In the life of an individual a character is more firmly fixed in comparative old age than in youth. Consequently we may assume in the absence of evidence to the contrary, that other things being equal, the older individual will be prepotent over the younger one." Redfield's work deals with human statistics and he aims to prove use-inheritance in the case of acquired mental powers.

It is apparent of course that color is not an acquired character except to a limited extent in regard to which the present data show nothing. It is rather obscure as to what may be meant by a character becoming more fixed by age. But that the power of a parent to influence the character of the offspring may be correlated with the time of life and consequent vigor is a matter seemingly independent of whether acquired or congenital characters alone may be transmitted. On the whole these data show that the influence of age is confined within narrow limits at least.

Conclusions.

1. There is a secular change of color in progress in the breed resulting from breeders' preference for black.

2. Gray, the long-established color, is prepotent over black.

3. The dam is prepotent over the sire in the ratio of about five to four. Gray dams are more prepotent than black dams and gray sires than black sires; also gray dams are more prepotent than gray sires and black dams than black sires. The dam's prepotency is partly due to association with the long predominant color. Gray dams and black sires are greatly in excess (nearly 75 per cent. of all).

4. There is apparently a degree of correlation between age and prepotency.

5. There appears to be an optimum age of prepotency, occurring in middle life.

In an appendix are added some further tabulations of the data of Table I., testing those results by Galton's Law.

The data given in Table I. were collected under the direction of Prof. C. B. Davenport at Chicago, with a view to testing the application of Galton's Law of Ancestral Heredity, but since the manifest action of breeders' selection has vitiated the data for deductions as to normal inheritance, for a series of generations, it is not worth while to include here any consideration of Galton's Law.

I wish to thank Mr. S. D. Thompson, Secretary of the Percheron Horse Breeders' Association, for access to unpublished records.

Appendix: The Data of Table I. in Relation to Galton's Law.

It was stated at the outset of this paper that the results of Table I. do not agree with Galton's Law of Ancestral Heredity, showing an abnormal proportion of black offspring, a fact doubtless due to breeders' selection. The excess of blacks is clearly seen by inspection without the use of Galton's method of calculation, since the per cent. of black offspring is greater than the per cent. of black parents, and the latter are greatly in excess of the number present in the two preceding generations. Galton's method of calculation was applied to these data, but it is not worth while to include those calculations here in view of the fact that the manifest action of breeders' selection has vitiated the data for deductions as to normal inheritance. The general result of the calculations may be given, however. They were made according to Galton's original method, not by Pearson's method of correlation, by which he makes use of far more data than the ancestry of 179 individuals would furnish.

The results are briefly: Out of 179 offspring the number of blacks calculated was 74, the actual number being 91. Of the grays the number calculated was 77, the actual number was 64. The bay-brown group exceeded calculations considerably, comprising the remaining 24 individuals.

At the right in Tables XV.–XVI. are given the per cents. of blacks and grays in the consecutive classes beginning with those

having the highest amount of the same color in the ancestry and running down. The series run:

Grays,	83	65	61	44	17	2	0
Blacks,	100	91	79	38	( )	14	0

Comparing these series it is seen that the top class of blacks comprises 100 per cent. of black individuals and, throughout, the series runs higher than for the grays. This may be interpreted as the result of breeders' selection either wholly or in part, a

TABLE XV.

SHOWING NUMBER OF BLACKS IN ANCESTRY OF 179 INDIVIDUALS, FOR THREE ANCESTRAL GENERATIONS.

No. of Black Parents.	No. of Black Grand-Parents.		No. of Black Great-Grandparents.										Per Cent. of Blacks.
			8	7	6	5	4	3	2	1	0	Totals	
	4	*a*		1	1	1	6	4	1		1	15	
		b		1	1	1	6	4	1		1	15	100
	3	*a*				9	1	3		1		14	
		b				9	1	3		1		14	
2	2	*a*				4	5	5	2	2		18	
		b				4	5	4	1	2		16	
	1	*a*					1		1	1		3	
		b					1		1	1		3	90.9
	0	*a*							1			1	
		b							1			1	
	4	*a*							1			1	
		b							1			1	
	3	*a*				4	8	5	1			18	78.9
		b				3	6	4	1			14	
1	2	*a*			1	7	5	3	6			22	
		b			1	3	2	1	3			10	
	1	*a*				3	1	6	3	3	2	18	
		b				2	1	3	1	0	0	7	38
	0	*a*					2		3	3	2	10	
		b					1		1	0	0	2	
	4	*a*											
		b											
	3	*a*											
		b											
0	2	*a*				2	2	2	7	7		20	
		b				1	2	1	1	1		6	
	1	*a*				3	3	3	11	1	6	27	13.5
		b				0	1	1	0	0	0	2	
	0	*a*						1	7		4	12	
		b						0	0		0	0	0
	Totals.	*a*										179	
		b										91	

NOTE.— *a* equals number in class; *b* equals number of blacks.

matter which is wholly beyond determination. It has been discussed above whether these results show the effects of inbreeding of blacks (p. 271).

Galton's law and Pearson's modification of it have both been criticised by advocates of the Mendelian hypothesis (Castle, '03). It is not included in the purpose of this paper to consider that law except in incidental connection with Tables I., XV. and XVI.

TABLE XVI.

SHOWING NUMBER OF GRAYS IN ANCESTRY OF 179 INDIVIDUALS, FOR THREE ANCESTRAL GENERATIONS.

No. of Gray Parents. I.	No of Gray G. P. II.		No. of Gray Great-Grandparents. III.										Per Cent. of Grays.
			8	7	6	5	4	3	2	1	0	Totals.	
2	4	*a*	3		4	1						8	83.3
		b	3		3	1						7	
	3	*a*	5		6	3	1		1			16	
		b	4		6	2	0		1			13	
	2	*a*		2	8	1	5		1			17	64.7
		b		2	3	1	4		1			11	
	1	*a*											
		b											
1	4	*a*		2	4	1	1					8	60.7
		b		2	4	0	0					6	
	3	*a*	5		6	5	1	3				20	
		b	4		3	3	1	0				11	
	2	*a*			8	2	3	7	3			23	43.7
		b			5	2	1	4	1			13	
	1	*a*			1	2	4	1		1		9	
		b			0	0	1	0		0		1	
0	4	*a*			1							1	16.7
		b			0							0	
	3	*a*			3		1	1				5	
		b			1		0	0				1	
	2	*a*		2	2		10	4				18	2.3
		b		0	0		1	0				1	
	1	*a*			1	2	6	14	2			25	
		b			0	0	0	0	0			0	
	0	*a*		1	1	3	7	12	3	2		29	0
		b		0	0	0	0	0	0	0		0	
	Totals.	*a*										179	
		b										64	

NOTE.—*a* equals number in class; *b* equals number of grays.

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